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Call Census, Habitat Suitability Modeling, and Local Communities' Perceptions for the Conservation of a Globally Threatened Avian Flagship Species

Abid Ali[1*]   Iftikhar Uz Zaman[2]   Abbas Khan[3]   Masoud Yousefi[4]   Zahid Ali[5] Muhammad Numan Khan[6]

1. Department of Biology, Government Degree College Akbarpura, Nowshera, 24100, Pakistan
2. Peshawar Zoo, Wildlife Department KP, 25000, Pakistan
3. Department of Statistic, University of Peshawar, 25000, Pakistan
4. Department of Environmental Sciences, Faculty of Natural Resources University of Tehran, Karaj, 31587-77871, Iran
5. Department of Geography, Government Degree College Akbarpura, Nowshera, 24100, Pakistan
6. Department of Zoology, Quaid-i-Azam University Islamabad, 45320, Pakistan

ARTICLE INFO	ABSTRACT

The Western tragopan (Tragopan melanocephalus) is recorded in the IUCN Red List of 2017 as a vulnerable bird species in Pakistan. This study provides valuable information for the conservation of Western tragopan, which is a globally threatened avian flagship species in Pakistan. This study was conducted to investigate and resolve the conservation challenges surrounding the species in two major habitat zones - Salkhala Game Reserve and Machiara National Park. The study was implemented in May-June 2020 for population density using call count data. Also, questionnaire was used for local residents' perceptions and habitat suitability modeling map was generated using the MaxEnt model based on previously recorded occurrence points as well as recorded in the survey. A total of 26 western Tragopans were identified by call count during the sampling period. Moreover, about 77.3% cited Western Tragopan they more likely to hunt while the remaining 22.6% locals recorded other pheasant. About 45.3% of this hunting for fun but only 22% for economic values and only 3% of people consider hunting as a part of their culture. Results of modeling habitat suitability of the Western tragopan showed that the species suitable habitats are small and patchy in Pakistan. We found that the Normalized Difference Vegetation Index (NDVI) with 40.6 percent contribution was the most important variable in shaping the species distribution. Our model identified some new suitable patches which can be the target of future field monitoring for finding new populations of the species and future conservation planning.

*Corresponding Author:
Abid Ali,
Department of Biology, Government Degree College Akbarpura, Nowshera, 24100, Pakistan;
Email: abid.biosci@gmail.com

1. Introduction

The planet is currently experiencing a sixth mass extinction [1] due to climate change, over-exploitation, environmental variation, natural disasters, and habitat destruction [2]. In light of this global extinction crisis and the continuing increase in the number of globally threatened species [3], prioritizing conservation action and funding is arguably more important than ever [4]. The process of urbanization exerts drastic changes in natural landscapes, with the complexity of urbanized zones driven by human activities that are based on social, cultural, and political drivers [5]. Such activities have had large adverse impacts on key bird species. For example, many pheasants hold a central position in the food webs of their native ecosystems, but are facing extinction due to human exploitation and habitat loss [6]. Their colorful plumages and charismatic breeding displays have made them prominent figures in traditional folklore and conservation campaigns, as well as cultural icons appreciated by native people and the mainstream public [7]. In particular, the Western tragopan (*Tragopan Melanocephalus*) subsequently referred to as 'Tragopan', an endemic and extremely elusive pheasant of the Western Himalayas, has been greatly affected by human influences, resulting in its IUCN Red List Vulnerable status (2017).

In Pakistan, the tragopan is distributed in and around Palas Valley and adjacent areas of Kohistan, Kaghan valley in the Khyber Pakhtunkhwa Province, Machiara National Park, Salkhala Wildlife Sanctuary, Pir Chinasi, and Pir Hasimari in Azad Jammu and Kashmir state of Pakistan [8-10]. The species is a brilliantly plumaged, ground-dwelling bird that shows high sexual dimorphism though no clear demarcation between juvenile females and males [11,12]. Adult females have black patches and central white streaks on their feathers while adult males have numerous white spots, each spot bordered with black and deep crimson patches on the sides and back of the neck [12]. Males also possess a naked throat (lappets) used to attract females during the breeding season [13]. Males are larger in size (body length 65-75 cm; weight 1.9 kg to 2.3 kg) than females (body length 60 - 65 cm; 1 kg to 1.7 kg) [12]. They live in broadleaf and coniferous forests with thick undergrowth and bamboo at elevations of 2,400-3,600 m [14]. The species is adapted to mountain having a dense shrub layer which indicated as the function of high disturbance and hunting rates [9]. Tragopans prefer to stay in places with no human disturbance and are confined to extremely steep terrain [7]. They move down in elevation during the winter season to lower valleys due to snowfall, which reduces the food resources available to them. They then return to higher elevations during the summer season [9].

The specie's vulnerable status is attributed to its small and sparsely distributed declining population with increasingly fragmented habitat and continuing forest loss throughout its range [15] (IUCN 2014). Current estimates suggest a global population of approximately 5,000 individuals [16], which is thought to be roughly equivalent to 3,300 mature individuals [16,17]. However, this number may be smaller than previously thought, which may warrant moving the species to endangered status [15]. Throughout its range, the tragopan is termed 'the King of Birds' among local communities. It is commonly regarded as an important flagship species for the fragile mountainous forest ecosystems where it occurs [18,19] but faces numerous conservation challenges with areas of its range being data deficient, such as the Salkhala Game reserve and Machiara National Park of Pakistan.

People of Azad Jammu and Kashmir state of Pakistan depend on ~90% of the surrounding forests for their livelihood [20]. This is reflected by the concessions granted to local farmers for unrestricted grazing of livestock, including within protected areas [21]. Together with the common local practice of maximizing livestock numbers for reasons of honor and prestige instead of quality, overgrazing of alpine pastures and the surrounding forests result in widespread suppression of forest regeneration. In a country where only ~5.1% of its total territory is forest (Food and Agriculture Organization, 2019) and significant demands are being made on this natural resource, this is further stressed by illegal logging [18]. Furthermore, illegal hunting and weak law enforcement add to the major regional conservation issues. Poaching of tragopan is done using different techniques and traditional pitfall traps were found to be used [22].

In the rural areas of developing countries, such as the Himalayan forests in Pakistan, land use is boosted to improve the production of agriculture materials [23]. The Himalayan Forest is the most destroyed among the globe's [24], due largely to degradation from sedentary livestock overgrazing, nomadic activities, legal as well as illegal tree cutting and tree harvesting [25]. More than 96% of agriculture growth in Pakistan are causing deforestation [25]. On the other hand, cattle incasement and pasture creation as it is a best source of income are also the main reason of deforestation in the Himalayan Forest [26]. Also, these forests are assumed to be the most vulnerable and fragile to climate changes [27] and many species, especially birds have threats due to fragmentation and degradation of forest [28,29].

For this study, we sought to obtain data points for call counts based on suggestions from local residents who have been working for years in the observed areas, but also

used the occurrence points for a habitat suitability model reported in previous studies (cite the studies). Specifically, we aimed to: (1) determined the number of birds using a standard method call count census recommended by [17], and also to compare the present counting with studies previously recorded for the same species at both study areas owing to evaluate if the population is increasing or decreasing, and (2) interview the local community to determine perceptions, and current knowledge base surrounding the species. Finally, we (3) aimed to find a habitat suitability model for this iconic species in order to know the future challenge for this bird.

2. Materials and Methods

Study area

The study was conducted in two major zones (see Figure 1). The Salkhala Game Reserve (SGR) and Machiara National Park (MNP). SGR (8.1 km², 34.33° N and 73.50° E) and its surrounding area are situated 80 km to the north-east of Muzaffarabad city, the capital of Azad Jammu and Kashmir, Pakistan. The area borders the Line of Control (LOC) with India on three sides whereas the river Nelum along with human settlements confines the north-western side of the reserve. SGR falls under the IUCN's protected area Category IV (Habitat/Species Management Area) with an altitudinal range between 1,320-3,150 m [8]. The area has a mean annual rainfall of 1257 mm with March and April being the wettest months, and heavy snowfall during the winter months [30].

Machiara National Park which is located in the Himalayan mountains of Azad Jammu and Kashmir Pakistan. This national park is located on the northeast of Islamabad with total distance of 165 km MNP (34310 N, 73770 E). The mean annual temperature range is 13.6-27.3 °C with four distinct seasons, for example winter is considered from December to February, spring from March to April, summer of the area is assumed to start from May and ending in August while the autumn season is beginning in the September and reach up to November [31]. The rainfall such as mean annual is recorded nearly 1526.7 mm and average days per year recorded for rain is about 84.5; November is assumed the driest month with 35.4 mm and July is considered the wettest month with 327.6 mm and this might be due to monsoon that is starting from July to August. MNP is the home of one of the world's most attractive hotspots for biodiversity within Himalayan mountains [32].

Forests in the study area are dominated by conifers, with broad-leaved associates, shrubs and a rich the undergrowth of herbs and grasses. Conifer tree species include west Himalayan fir (*Abies pindrow*), west Himalayan spruce (*Picea smithiana*), Himalayan cedar (*Cedrus deodara*), blue pine (*Pinus wallichiana*), Himalayan yew (*Taxus wallichiana*), brown oak (*Quercus semecarpifolia*), Himalayan maple (*Acer caesium*), walnut (*Juglans regia*), Himalayan birch (*Betula utilis*) and idian horse chestnut (*Aesculus indica*) while some Important animal species living within the study area include the common leopard *Panthera pardus,* snow leopard *Panthera uncia*, leopard cat *Prionailurus bengalensis*, Himalayan black and brown bear *Ursus thibetanus*, Asiatic jackal *Canis aureus*, red fox *Vulpes vulpes*, yellow-throated marten *Martes flavigula* and golden eagle *Aquila chrysaetos*. Himalayan temperate forests have some Endemic birds including western tragopan, cheer pheasant *Catreus wallichii* and Kashmir flycatcher *Ficedula subrubra*, although recent surveys have failed to locate cheer Pheasant or Kashmir flycatcher [18,31].

Data collection

A reconnaissance survey was conducted in May-June 2020 to identify potential habitat of the study species. Information surrounding tragopan occurrence was gathered from park employees and review literature [18,33] based on which study plots were selected in the potential habitat of species. Study sites were selected based on researcher accessibility to the area. The two major zones, SGR and MNP were further divided into survey plots shown in Table 1.

SGR was divided into six plots, each with a single point based on the presence of the bird confirmed by a departmental survey specialist and given the fact that total area of the reserve is about 5.5 km². Two survey teams were selected, each with a lead observer and an assistant. MNP on the other hand cover 135 km square and the divided into ten recommended plots again with single points based on previously recorded hotspot for the bird [33] and on local people information as they are familiar with many species traditionally as well as culturally. Average size of each plot was about 5x5 km² and the field work was carried out with three survey teams and each plot was surveyed nearly two times a week for one-month Table 1.

Due to resources limitation, we used call count census to record the number of tragopan number at each point, which is a well-known method used in previous literature following the method [34,35]. Himalayan pheasants are best surveyed in May to June when they are breeding and tend to be most vocal [18] and the reason we followed the suggested time period to study the species. Call counts were conducted in a radius of 300 m from the center of each plot to confirm the presence of the species and the numbers using call count method. Single points were then selected from each plot and then monitored once at

dawn, starting at 04h00 [34,36]. Once calling started, surveys continued for 30 minutes; no surveys continued after 05h20, method used by [37]. Finally, for MaxEnt model, we used the occurrence points reported in literature [10,35].

Questionnaire survey

Residents occupying heavily forested parts of the study area where Tragopan were likely to be present were interviewed. We interviewed both adult men and women (>18-years-old). Consent of the interviewee was sought during the survey and we recorded majority of respondents were men, potentially influenced by cultural barriers and/or restrictions that made women unlikely to interact with strangers, including the researchers.

To collect information on respondents from the area, we designed a semi structured questionnaire with the following sections: (1) Socioeconomic and demographic characteristics (history of education, livestock owned, land ownership, sources of Income, and economic losses), (2) experiences of Tragopan such as breeding season, trend of population, forest type and grazing area former used, and (3) attitudes toward bird conservation (i.e., asking whether respondents wanted tragopan to be hunt or not). A total of n=6 village was grouped into two major regions: SGR and MNP. Stratified random sampling was used to ensure that a representative number of households were interviewed. Villages were categorized based on three variables: previous records of birds, amount of forested area, and elevation. In each village, more than twenty individuals were interviewed depending on the area's accessibility and presence of occupants.

Hunting Western tragopan is illegal under the rule of Pakistan Wildlife Act. We asked common questions in order to evaluate the attitudes of locals towards tragopan. Thus, questions surrounding killing of the species were indirectly linked to other questions which could encompass the tragopan such as 1) which one bird people liked to hunt, 2) What kind of lethal technique they used, 3) Why they liked to hunt, and 4) What is the preferred time people hunt for the bird?

Environmental variables

To generate a habitat suitability model for Tragopan in Pakistan we used climatic, topography, and vegetation Normalized Difference Vegetation Index (NDVI) variables [38,39]. Climatic layers were downloaded from Wordclim (https://www.worldclim.org/) at 1 km² spatial resolution [39]. For including topography in MaxEnt model we considered topographic heterogeneity and slope. These variables were created using the Raster [40] based on the Shuttle Radar Topography Mission (SRTM) elevation model [41]. We performed a Pearson correlation test to identify highly correlated variables (r> 0.75) and found that all variables had low correlations (r< 0.75).

Data analysis

First, we calculated the mean call counts of Tragopan from all plots of both zones, SGR and MNP. We also compared call counts of Tragopan with the previous surveys that had done for both zones [10,35,36].

Any questionnaires with incomplete information (n =16) were removed for accurate analysis. Once we collected samples, a chi-square test was used to evaluate associations between variables. For example, "Bird Status" was recorded as either increasing or decreasing as a dependent variable with "Place" serving as the independent variable. During the analysis of the data from the attitudes, we used the type of bird people liked to hunt as a dependent variable and the remaining questions such as time they preferred and reason why people hunt the bird kept as independent variables. All statistical data were analyzed using dedicated software (SPSS, Version 25 Chicago, IL, USA) with statistical significance set at .05 [42].

MaxEnt modeling of the western tragopan

Species distribution models (SDMs) use species presence data and environmental variables and predict distribution of species in space and time [43,44]. SDMs are useful in predicting distribution of ecologically unknown avian species [45,46] and identifying high priority areas for their conservation [47]. In the present research we used Bioclimatic data downloaded from the Worldclim website [39] (WorldClim 2021), and the one remote sensing variable NDVI were downloaded from Copernicus and Nasa Earth Observations websites (Copernicus 2021; NEO 2021). All the variables were downloaded and set up with same resolutions such as 30 arcsec. We used MaxEnt 3.4.1 [44] to model habitat suitability of the Western tragopan (*Tragopan melanocephalus*) in Pakistan. MaxEnt was run with a maximum of 1000 iterations, a convergence threshold of 0.00001 and 10,000 background points [44] MaxEnt model performance was assessed using the area (AUC) under the receiver operating curve (ROC) [48]. We used the cross-validation approach and distribution records were randomly split into 10 folds containing equal number of occurrences, and training models were created by eliminating each fold in turn [49].

3. Results

Call counts of Tragopan

We recorded a total of (n=26) Tragopan calls during the sampling periods in SGR and MNP Table 1. In SGR, a total of n=12 call counts with a (mean= 2.00 and SD=1.673) were found while in MNP, a total of n=14 bird call counts were recorded with the (mean=1.40 and SD=0.516). Within plots of both zones, plot five

alone in SGR was recorded with the highest call counts (5 call counts) from the rest of the plots in both zones. Additionally, the Wilcoxon value for SGR was (Z= 0.447 Vs P value=0.655) and for MNP was (Z=0.000 Vs P value=1.00) which revealed that there was no significant change in the population of the bird in MNP while there was a slight decrease in population of SGR with the mean decreasing from 2.17 to 2. For habitat use, Tragopan were observed more (n= 14) in the broad mixed coniferous broadleaf forest than in pure conifer forests and the first month of May was recorded as a favorable season for calling in the study area. Tragopan began calling as early as 0415 hrs. and gradually increased, with a peak at 0500-0514 hrs and they stopped calling by 0530 hrs.

Local community threats to W. Tragopan

In response of the general perception and attitude toward Tragopan in both study sites, we recorded (n= 150) around both zone SGR and MNP. Mainly 54% of respondents cited decreasing the number of species in both major zones. The Chi-square detected a strong significant association among both places for decreasing population (see Table A1; Chi-square = 20.478, P=.000). In order to know about the breeding season, we recorded a total of 48.6% observation with April-May is the breading season of this bird in the area while 22% cited July to August, 7.3% other, and finally not known with 22%. For breeding season information, place remained significant (see Table A2; Chi-square test= 23.392, P=.000).

For timber collection, more than 59% of people cited a mixed coniferous broadleaf forest as a better source for temper and medicinal plant collection and only 40% were recorded for others. The significant association between the status of the bird and forest type used by the local community was recorded as significant (Chi-square test =13.607, P= .001) but a weak association was found for people using the forest in a different place (see Table A3; Chi-square test=8.247, P= .004). For livestock grazing, the majority (57%) of people liked to graze in the dense forest while only 42% cited open pasture. Nearly, all respondents were recorded with one or two dogs for livestock guarding in both the study sites.

Moreover, about 77.3% of respondents like to hunt Tragopan while the remaining 22.6% hunted other pheasant in the study area. The local people cited 45.3% of this hunting for fun, 22% for economic purposes while only 3% of people consider hunting as a part of their culture. Nevertheless, we recorded 29% of respondents as being unfamiliar with hunting. A weak significant effect was found between both zones and reason people hunt the bird (see Table A4; Chi-square test =9.60, P= .022). To know about suitable hunting times of the bird, people cited 68% in April-June, June to August 45% and other 6% while 29% recorded they do not know the exact time people like to hunt W. tragopan. Logistic regression shows weak significant relation between choice of bird people like to hunt in the area and suitable time hunting (B=.453, Standard Error=.331, Wald=1.873, Exp B= 1.573, P=.171) but strongly significant for the reason they hunt among both zones Table A5.

Habitat suitability model and variable importance

Based on AUC metric the habitat suitability model generated in this study for the Western tragopan performed well, mean AUC = 0.99. Results of modeling habitat suitability of the Tragopan showed that the species suitable habitats are small and patchy in Pakistan. Based on MaxEnt model 3729 km^2 suitable habitat identified for the species in the country. We found that NDVI with 40.6 percent contribution was the most important variable in shaping the species distribution followed by slope with 33.5% contribution, annual precipitation with 20.4% contribution, annual temperature with 3.4% contribution and topographic heterogeneity with 2.6% contribution (Figure 2).

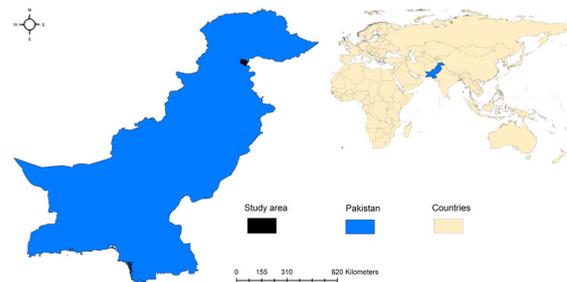**Figure 1.** Location of the study area in Pakistan and global position of Pakistan among the other countries. Map was generated using QGIS 3.4.1 (https ://www.qgis.org).
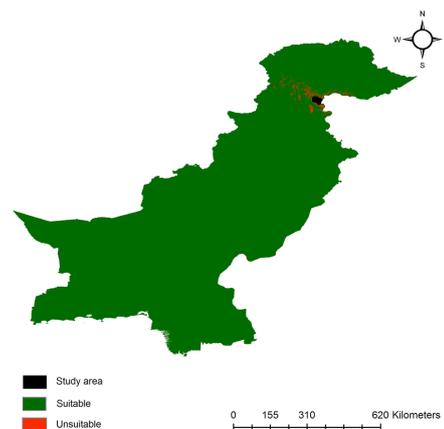

Figure 2. Habitat suitability model of the Western tragopan (*Tragopan melanocephalus*) in Pakistan. Map was generated using QGIS 3.4.1 (https ://www.qgis.org).

Table 1. Providing information of sites in each zone, habitat types and distance cover in the present study for counting bird during survey period.

S. No	Sites	Altitudes (m)	No. of calling	Survey in km²	Habitat	Previously recorded No. of call
Zone one (SGR)			Current study		Broadleaf-conifer Forest	Awan and Buner, 2014 [18]
Plots 1	Outside reserve	2,821	0	0.5	-	1
Plot 2	Outside reserve	2,875	2	1	-	3
Plot 3	Inside reserve	3,158	1	0.5	-	2
Plot 4	Inside reserve	2,651	2	1	-	1
Plot 5	Outside reserve	3,166	5	1	-	4
Plot 6	Outside reserve	3,105	2	1	-	2
Total	-	-	**12**	**5**	-	**13**
Zone two (MNP)					Broadleaf forest	Shabbir et al. 2018
Plot 1	Raveri	2819	2	0.5	-	2
Plot 2	Mali	3169	1	0.3	-	2
Plot 3	Kuthiali	3072	2	0.5	-	1
Plot 4	Moryan	2522	1	0.4	-	1
Plot 5	Charyal	2812	1	0.3	-	1
Plot 6	Roshan wala nullah	2911	2	1	-	1
Plot 7	Kuldaper	3328	1	0.5	-	2
Plot 8	Chita Kushkar	2993	1	0.5	-	2
Plot 9	Sehr	3134	2	1.3	-	1
Plot 10	Daper	3295	1	0.6	-	1
Total	-	-	**14**	**5.9**	-	**14**

4. Discussion

The Tragopan is listed as a vulnerable species in Pakistan as per IUCN Red List (2017). This species is located mainly in and around Machiara National Park and Salkhala game reserve [9]. The results of the present study are comparable with the findings of other studies conducted in Pakistan which indicate that this species has sustained its population in Machiara National Park [10]. We recorded a lower population using a call count census in the Salkhala game reserve compared to previous research [9]. Nevertheless, the plot five alone in Salkhala was a hotspot for this bird, containing a higher number of calls from the rest of the plots in both zones. The reason of high number of bird calls at this plot is due to higher altitude than other plots. Studies have demonstrated that the relative abundance of pheasants were always higher at high altitude [37]. Overall, our finding shows no too much deviation from the finding of other researchers who carried out studies from both zones in Pakistan [33,35]. However, call count is a traditional method and therefore, we suggest using advance techniques and equipment in order to report the exact number population density, relative abundance and distribution of this globally threaten species from Pakistan. Moreover, our finding suggested that Tragopan prefers a habitat on higher elevation within broad-leaved and conifer forests which is similar to the finding of researchers from the Great Himalayan National Park, India [37].

Majority of local people admitted that the species have higher threats in SGR and numerous decreases in its population has been reported over the past decades. This might be the reason of unsustainable harvest. For example, the community involved in illegal cutting the forest including fine shrubby vegetation that is used by pheasants for shelter and breeding (unpublished, office data). Also, high pressure of human activities in the area including recreational purposes as well as war and terror in the region. For example, SGR is in close touch with Indian boarder and military operations is quite common from both sides of the boarders. Local people are economically weak and local searching forest for wild vegetables for immediate consumption or to dry for winter use, including *Dryopteris, Mentha*, *Phytolacca,*

Polygonum, *Rumex*, *Plantago*, Angelica and *Dipsacus* [36]. Collection of morel mushrooms Morchella sp. is common and widespread in the mountains of northern Pakistan and due to their high financial value for food and medicinal values as a treatment for pneumonia. Thus, local people concentrate on forest that serve as a major economical reserve for them. Meanwhile, in a country where only around 5.1% of its total territory is forest (Food and Agriculture Organization, 2019) and significant demands are being made on this natural resource, worsened by illegal logging by logging companies [36], legal as well as illegal tree cutting and tree harvesting [25] that make the Himalayan Forest are the most destroyed among the globe's [24]. Nevertheless, more than 96% of agriculture growth are involved in diminishing forest [25] and that is why the Himalayan is the most vulnerable and fragile to climate changes [27]. On the other hand, our report suggests that majority of respondents keep dogs to protect the livestock from the regional carnivore's attack present in the area. For example, from the finding of [31] who suggested that dog can play a significant role in protection of livestock from a predator. However, dog can disturb the presence of birds including the tragopan using scent for active hunting [8].

Hunting is one of the major threats to the pheasants in the study area and this could be due to no proper protection strategy and lack of proper wildlife protection staff in the area to mitigate hunting and other threats to the birds**.** Community responses suggest that the majority of people engage in hunting for fun rather than economic purposes and the study revealed that hunting pressure is particularly high for Galliformes in the Salkhala reserve [8], with hunting for food, skins, or recreation conducted by local and non-local professional (trophy-hunting) and non- professional hunters alike. This could be the reason we recorded a lesser number of tragopans at SGR as compared to MNP. On the contrary, illegal hunting typically results in population depletion and in the worst cases may lead to the loss of species [50] and to loss of revenue due to reduced opportunities for wildlife tourism.

Results of habitat suitability modeling revealed that the Western tragopan has small and fragmented habitats in Pakistan. Our MaxEnt model estimated 3729 km² suitable habitat for the species. Comparing this with results of previous study on this species which identified 1294 km² suitable habitat for the species [51] showing that the species distribution and ecology are poorly understood in the country and highlights the importance of SDMs in studying ecologically unknown species. Habitats which were identified with high suitability are ideal targets for selecting new protected areas or redesigning current protected area networks for conservation of avian diversity in the country. We found that NDVI is the most influential factor in predicting the species suitable habitat highlighting the importance of vegetation cover for species long term survival. NDVI was identified as the most effective environmental variable in predicting suitable habitats of forest dweller birds by other researchers [47]. Our model identified some new suitable patches which can be target of future filed monitoring for finding new populations of the species. Since agricultural development and human disturbance can negatively influence the species, we recommend prohibition of land use change and human disturbance in highly suitable habitats [51,52]. Climate change, which is an important challenge for biodiversity conservation [53] was identified as a threat for the species causing range shift to higher elevation habitats [54]. In this regard ensuring the species habitat connectivity can be critical for long term survival of the species under climate change.

5. Conclusions

In the light of this global extinction crisis and the continuing increase in the number of globally threatened species [1], prioritizing conservation action and funding it is arguably more important than ever. The Tragopan *melanocephalus* is an endemic and extremely elusive pheasant of the W. Himalayas. The Tragopan bird is higher at MNP in the most suitable place to have mix coniferous broad-leaved forest. However, the community is dependent on the forest where the income source is always timber and other plants. The population status was recorded to have decreased mostly due to the local community response. Respondents reported that most people liked to hunt Tragopan more than other birds and primarily hunted for non-economic purposes, such as leisure. Thus, the birds face immense challenges for its population sustainability in the Azad Jammu and the Kashmir state of Pakistan due to rapid human influence and forest change scenarios. Therefore, the present study recommends strong monitoring of the bird and proper staff for surveying of the bird. The government should educate the department's employers for such conspicuous birds. We also recommend some further studies in the region for this bird particularly the genetic basis conservation which is still elusive in order to evaluate the genetic diversity for the species.

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Author Contributions

A.A. and I.Z conceived the study, participated in its design and coordination, A. A gave a critical view of manuscript writing and performed screening, A K, analyzed the data statistically. M Y performed habitat suitability model and participated in writing associated parts in the manuscript. M N K conducted the field work as well as performed in writing associated part of the manuscript. All authors contributed to the writing and reviewing the manuscript.

Conflict of Interest

The authors declare no competing interests.

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Appendix

Table A1. Population Trend (dependent variable) of the Tragopaneither increasing or decreasing among the places. The place remained independent variables.

Population Trend	Place		Total	Chi-square/Pearson value	P value
	SGR	MNP			
Increasing	18	11	29		
Decreasing	59	22	81	20.478	.000*
Not know	12	28	40		
Total	89	61	150		

Table A2. The breeding season information among the different places. Breeding season, a dependent with the place which is an independent variable for the model.

Breeding season	Place		Total	Chi-square/Pearson	P value
	SGR	MNP			
April to June	51	22	73		
June to August	6	27	33		
Other	10	1	11	31.796	.000*
Not known	22	11	33		
Total	89	61	150		

Table A3. Showing the relation between forest types people used in both Zones.

Types of Forest Used	Place		Total	Chi-square/Pearson	P value
	SGR	MNP			
Mixed coniferous forest	63	26	89	31.796	.000*
Other	29	32	61		
Total	92	58	150		

Table A4. The reason, (dependent variable) people like to hunt the bird for different purposes, the independent variable, place for chi-square value.

Reason People Hunt the Bird	Place		Total	Chi-square/Pearson	P value
	SGR	MNP			
Fun	43	25	68		
Economic Purpose	25	8	33		
Tradition	2	3	5	9.650	.022
Not known	19	25	44		
Total	89	61	150		

Table A5. The binary logistic regression model with dependent variable bird people like to hunt with two independent variables such as Time and Reason.

Variables	B	S.E.	Wald	Df	Sig.	Exp. (B)/Odd ratioLower	95%C.I.for EXP(B)	
							Upper	
Reason	-1.280	.336	14.550	1	.000	.278	.144	.537
Time	.453	.331	1.873	1	.171	1.573	.822	3.009
Constant	-1.344	.499	7.261	1	.007	.261		